

NETL Hybrid Program

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Definition of Hybrid System

- It is not a Combination of an Internal Combustion and Electrical Engines
- It is a Combined Cycle Containing a High-Temperature Fuel Cell +
 - Gas Turbine
 - Reciprocating Engine
 - Another Fuel Cell



Advantages of Hybrid Systems

- Optimized System 70%+ Efficient
- Environmentally Pristine
- Attractive COE
- Near-Term Components



Early Work

- Initially Conceived in Late 1980s
- Workshops in Morgantown in 1995 & 96
- Westinghouse FC Contract Signed on 8/22/97
- Hybrid PRDA Solicitation (1998)



NETL Internal Activities

- **In-house**
 - Integration of Fuel Cells and Gas Turbines
 - Dynamic Performance of Hybrid Systems - Experimentally & Numerically
- **Process Engineering Division**
 - Comparison of Hybrid Concepts
 - Framework Convention for Consistent Evaluations



1998 Hybrid Solicitation (PRDA)

- System Studies
- 20 MW
- 70% Efficient
- Near-Term Components
- Must Contain a High-Temperature Fuel Cell
- Operate on Natural Gas
- Cost of Electricity at Least 10% Less Than Conventional Systems



Awards for Fuel Cell/Gas Turbine Systems PRDA

Fuel Cell Manufacturer	Turbine Supplier	Type of Fuel Cell
Siemens Westinghouse	Allison Engine Company	Tubular Solid Oxide
Siemens Westinghouse	Caterpillar/Solar Turbines	Tubular Solid Oxide
FuelCell Energy Inc. (Energy Research Corporation)	Allison Engine Company	Molten Carbonate
M-C Power	Allison Engine Company	Molten Carbonate
McDermott/SOFCO	Northern Research and Engineering Corp	Planar Solid Oxide



General PRDA Results

- 70+% efficient systems are possible
- Start smaller than 20 MW
- Initial proof-of-concept systems will be 65-70% efficient



Issues

- **Tradeoffs**
 - Cost / Efficiency / Emissions
- **Fuel Cell - Turbine Integration**
- **Component Optimization**
 - Turbine
 - Heat exchangers
 - Power conditioning



Hybrid Power Systems Solicitation

- **Goal - Determine Hybrid System Problems**
- **Focus - Proof-of-concept systems of suppliers' market entry product**
- **Objective:**
 - 75% efficiency, less than this is acceptable for initial stage.
 - COE 10-20% less than conventional plants
- **System should contain existing or “near-term” equipment**



Future Actions

- No actions planned for FY 2001
- FY2002 - ?
 - Integration
 - Components

